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Factors influencing the reduction of plastic bag consumption in Cambodian supermarkets

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សង្ខិត្តន័យ

នៅឆ្នាំ២០១៧ រាជរដ្ឋាភិបាលកម្ពុជាបានដាក់ចេញអនុក្រឹត្យលេខ១៦៨ អនក្រ.បក ស្តីពីការគ្រប់គ្រងថង់ប្លាស្ទិក។ អនុក្រឹត្យនេះយកថ្លៃ០,១០ដុល្លារ (៤០០ រៀល) ក្នុងមួយថង់ពីអ្នកប្រើប្រាស់នៅតាមផ្សារទំនើប។ ទោះជាមានអនុក្រឹត្យនេះក៏ដោយ ការកាត់បន្ថយថង់ប្លាស្ទិកតាមបណ្តាផ្សារទំនើបនៅមានកម្រិតនៅឡើយ។ ការសិក្សានេះបានវិភាគលើកត្តាជះឥទ្ធិពលដល់ការកាត់បន្ថយថង់ប្លាស្ទិកតាមផ្សារទំនើបនានាក្នុងទីក្រុងភ្នំពេញនៃប្រទេសកម្ពុជា។ កត្តាទាំងនោះរួមមាន លក្ខណៈសេដ្ឋកិច្ចសង្គម ព័ត៌មាន ចំណេះដឹង អាកប្បកិរិយា ការអនុវត្តជាក់ស្តែង និងឆន្ទៈក្នុងការបង់ថ្លៃលើថង់ប្លាស្ទិក។ ការសិក្សាបានស្ទង់មតិអតិថិជនចំនួន៤០៣នាក់ នៅក្នុងផ្សារទំនើបចំនួន៥ទីតាំង។ ការសិក្សាបានរកឃើញថា កង្វះព័ត៌មាននិងចំណេះដឹង រួមទាំងអាកប្បកិរិយា និងការអនុវត្តមិនល្អ បានធ្វើឱ្យការកាត់បន្ថយថង់ប្លាស្ទិកជួបបញ្ហាប្រឈម។ អតិថិជនមានអាកប្បកិរិយាអវិជ្ជមានចំពោះភាពលំបាកនៃការកាត់បន្ថយថង់ប្លាស្ទិក។ ដូច្នេះ ការប្រើប្រាស់ថង់ប្លាស្ទិកមានចំនួនច្រើន (ចន្លោះពី១ទៅ៧ថង់) រាល់ពេលពួកគេទៅផ្សារម្តងៗ។ ឆន្ទៈបង់ប្រាក់របស់អតិថិជន(WTP) មិនតំណាងឱ្យចំនួនថង់ប្លាស្ទិកដែលពួកគេបានប្រើប្រាស់នោះទេ។ ដូច្នេះ ការសិក្សាបានស្នើឱ្យបង្កើនថ្លៃរហូតដល់ ០,១២៥ ដុល្លារ (៥០០រៀល) ក្នុងមួយថង់ ដើម្បីឱ្យការកាត់បន្ថយថង់ប្លាស្ទិកមានប្រសិទ្ធិភាព។ Binary Logistic Regression បានបញ្ជាក់ថា

ព័ត៌មាន ឥរិយាបថ និងការអនុវត្តល្អប្រសើរ ទំនងជាមានឥទ្ធិពលគួរឱ្យកត់សំគាល់ចំពោះការកាត់បន្ថយថង់ប្លាស្ទិកនៅតាមបណ្តាផ្សារទំនើបនានា។

Abstract

In 2017, the Royal Government of Cambodia (RGC) introduced Sub-Decree 168 on the Management of Plastic Bags. It legislated that a 0.10 USD fee would be paid by consumers for each plastic bag they were provided at a supermarket. However, the reduction in plastic bag consumption by supermarkets has been quite limited. This paper analyses the factors that influence the reduction of plastic bag use by supermarket customers in Phnom Penh. It considers socioeconomic characteristics, access to information, existing knowledge, attitudes, and practices, as well as the willingness to pay a fee to use a plastic bag. A survey of 403 customers in five supermarkets was conducted to assess these factors. The study reveals that lack of available information, and poor knowledge, attitudes, and practices presented challenges for the goal of reducing plastic consumption in supermarkets. The inconvenience of a reduction in plastic bag use was found to result in negative attitudes towards the fee. Plastic bag consumption remained high at 1 to 7 bags per visit to a supermarket. Willingness-to-pay the scheduled fee was shown to have minimal influence on the number of plastic bags they used. Thus, this study recommends an increase in the fee to 0.125 USD per bag. A binary logistic regression was used to show that greater access to information, as well as changes in knowledge, attitudes, information, would have a significant influence on the reduction of plastic bag use in supermarkets.

Keywords: plastic bag consumption; willingness-to-pay; Sub Decree 168; access to information; knowledge, attitudes and practices

Introduction

Plastic bags have become a popular packing method for consumers due to their ease-of-use, availability, and price (Adane & Muleta, 2011) and a

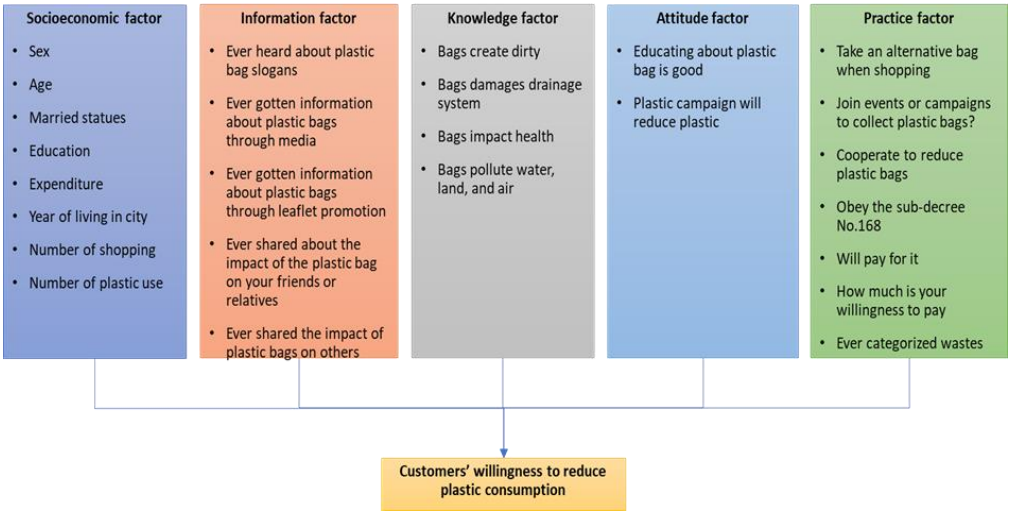
popular globally, especially in urban areas (Boadi & Kuitunen, 2003; Idris et al., 2004). In 2015, the worldwide annual production was estimated to be 381 million tons (Ritchie & Roser, 2018). Plastic waste is a major environmental concern (Wright & Kelly, 2017; Jang et al., 2020). The scale of plastic bag consumption is strongly correlated with customer behaviors, socioeconomic characteristics, knowledge, attitudes, and practices (Laroche et al., 2001). Encouraging consumers to reduce plastic bag use is considered useful in reducing this consumption (Verghese et al., 2006; Adane & Muleta, 2011) by changing consumer attitudes (Coddington, 1990). However, in Phnom Penh, the factors that may influence this change remain unclear, which is a key constraint to the success of policies (Koeng et al., 2020). Phnom Penh has the highest level of plastic bag consumption in Cambodia, at approximately 10 million bags in total per annum or 2,000 plastic bags for each person in the city each year (UNDP, 2019). The identification of the factors the influence the reduction of plastic bag consumption is considered to be useful information for developing more effective and policies and regulations to this end (Kum et al., 2005; Ritch et al., 2009).

This research explores the factors that influence the reduction of plastic bag consumption in Phnom Penh by analyzing customer behaviors in supermarkets. It first aims to identify the socioeconomic characteristics, information, knowledge, attitudes, and practices that influence plastic use among consumers. Second, it examines the willingness-to-pay (WTP) to reduce the consumption of plastic bags. Finally, it determines the factors that influencing plastic bag reduction in Cambodian supermarkets.

Factors Influencing on plastic consumption and reduction

Following a literature review, the factors influencing the reduction of plastic bag consumption and were placed into five categories. These included socioeconomic characteristics, access to information (policies and regulations), knowledge, attitudes, and practices. These are presented in (Figure 1).

Figure 1. Conceptual framework



Adapted from (Laroche et al., 2001)

Socioeconomic characteristics

The socioeconomic characteristics of consumers impact plastic bag consumption (Kaliyaperumal, 2004). Residential location, education levels, and occupation have been shown to influence a reduction in plastic bag use (He, 2012). A study conducted by (Berkowitz & Lutterman, 1968) claims that females, young people, those who are highly educated, and the middle class are more likely to reduce their use of plastic. (Zambrano-Monserrate &

Alejandra Ruano, 2020) have also found that female household heads are likely to use fewer plastic bags when shopping; and that urban people use more plastic bags than rural households. In the past, older people have been more likely to be concerned about the environment and as a result, use less plastic than younger people (Samdahl & Robertson, 1989). This is also confirmed by (Berkowitz & Lutterman, 1968), especially for single-use plastics.

Access to information

The Royal Government of Cambodia (RGC) has established four policies and regulations to reduce plastic consumption and manage its disposal (MoE, 2020). These include Sub-decree 168 on the Management of Plastic Bags, which charges a fee of 0.10 USD per plastic bag to customers of supermarkets; Sub-decree 235, on the Management of Drainage and Wastewater Treatment System that applies a penalty of between 12.5 USD and 1,250 USD to those who dispose of plastics into a drainage system; Inter-Ministerial Circular 1070 on State of Water Management in Phnom Penh and Sub-decree 113 on Urban Solid Waste Management. Campaigns are also conducted by NGOs aimed at increasing the number of items used per plastic bag (Quicksand, 2015). A reduce, reuse, recycle strategy has also been introduced at public and private institutions, as well as among individuals, with respect to reducing the consumption of plastic bags.

Access to information about policies and regulations related to plastic bag consumption is considered to be a major influencing factor in this study. Edwards & Kellett (2000) claim that government regulations and policies

facilitate the control and management of plastic consumption. Similarly, (Brucks, 1985) suggests that information encourages customers to change their decisions about careless plastic consumption. This is said to improve the knowledge, attitudes, and practices of customers (Chow et al., 2017). Thus, a lack of information about plastic reduction policies and regulations is considered to be a critical problem. In Cambodia, while information about plastic consumption and reduction policies and regulations have been transferred to customers, the enforcement of these policies has been limited (Koeng et al., 2020).

Customer Knowledge

Knowledge is defined in this study as an understanding of how the reduce plastic consumption that influences attitudes and practices. Knowledge is also related to using the information to make decisions (Brucks, 1985). Knowledge of plastic use from information campaigns can motivate customers to reduce their use of plastic (Reazuddin, 2006).

There is a range of arguments presented in the existing literature about the reduction of plastic consumption. (Afroz et al., 2017) analyzed the level of knowledge, awareness, and attitudes about plastic waste claimed that people who have more information and knowledge on plastic are more likely to recycle than those who don't. However, only knowledge related to the environment (e.g. plastic wastes pollute the environment, impact health, and kill marine life) was shown to make a significant contrition to the reduction of plastic use. Overall, the level of education (science and society) was not correlated with behaviors (Hasan et al., 2015). Thus, specific plastic

education has a greater potential to change people's attitudes and behavior towards the reduction of plastic consumption, and waste management (Chow et al., 2017).

Customer attitudes

Customer attitudes towards the reduction of plastic consumption may be categorized as being related to importance and inconvenience (Laroche et al., 2001). Importance is defined as the concern of customers for the environment and their willingness to reduce their use of plastic. This attitude is reinforced in their WTP for plastic waste management service through a plastic usage fee (Convery et al., 2007). Environmental concern is related to both personal and societal benefits. On the other hand, inconvenience is defined as customer feelings about reducing plastic consumption. For example, customers wish to use alternative bags when they shop, but this feels inconvenient. Recycling is considered to be good for the environment, but difficult and time-consuming.

Dilkes-Hoffman et al. (2019) claim that customers feel negative about plastic consumption, which has a strong correlation with plastic reduction. However, many customers cannot transfer this inspiration into action due to the inconvenience. This helps to explain the high WTP for plastic consumption, combined with the high usage rates of plastic bags.

Customer practices

Customer practices tend to be influenced by socioeconomic characteristics, access to information, knowledge, and attitudes (Chow et al., 2017). These practices can differ and include reducing waste, reusing,

recycling, or managing plastic waste; and may also be defined as consumer commitments to reducing plastic consumption and protecting the environment. For instance, consumers may be willing to support Sub-Decree 168, which introduces a 0.10 USD on the use of a plastic bag. They may also willing to co-operate to reduce their use of plastic when shopping; use alternative bags, or join a campaign to collect plastic waste in public spaces.

Figure 1 outlines a conceptual framework that illustrates how consumer willingness to reduce plastic consumption is linked to socioeconomic characteristics, access to information, knowledge about plastic, as well as attitudes and practices. These five factors help to assess customer behavior with respect to the reduction of plastic consumption. This paper uses this framework to discuss these concepts with respect to addressing the core problem of excessive plastic consumption, while also focusing on particular solutions that may be applied in Cambodian supermarkets. The five factors are used to demonstrate how customers act to reduce plastic consumption in response to policies such as Sub-Decree 168.

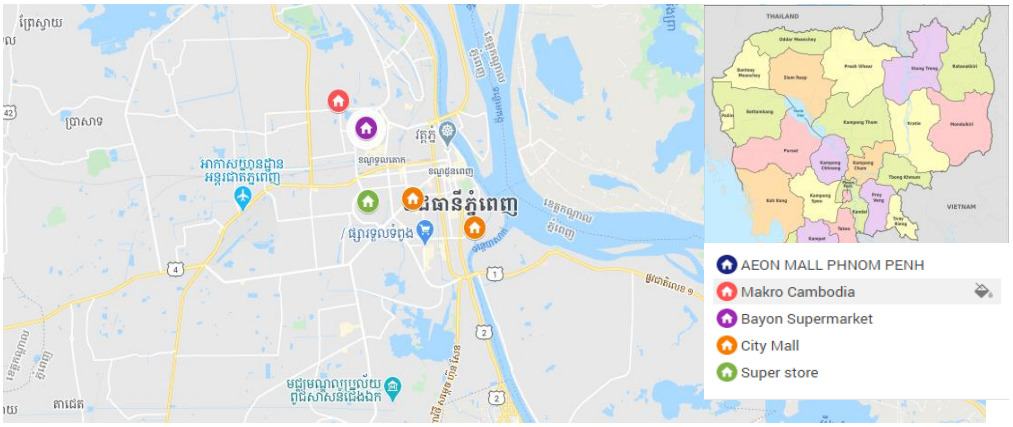
Research Methodology

This research uses an exploratory methodology to better understand the factors that influence the reduction of plastic bag consumption in supermarkets in Phnom Penh, Cambodia. To date, no studies have been conducted that identify these factors or determine the willingness to pay of customers to reduce plastic bag consumption in this context.

A purposive sampling approach was employed to select five research sites in Phnom Penh (see Figure 2). Three large markets (City Mall, AEON

Mall 1, and Rotana Plaza) were selected. These sites serve as entertainment zones that attract young adults as well. Two smaller markets were also selected that tend to attract older people (Super Store and Bayon Supermarket). Each of these supermarkets operate from 9 am to 10 pm, with a peak in shopper activity occurring in the evening. Late in the morning, customers visit the markets to purchase groceries. From the afternoon, until late evening, customers to buy food and drink items, as well as movie tickets and other forms of entertainment. Many types of single-use plastics are consumed in these supermarkets.

Figure 2. Study sites



Source: Google Maps

A sample of 400 customers of these supermarkets was selected based on a 95% confidence interval (Yamane, 1973) from a total population size of 1,470,303 of the Phnom Penh population in 2018 (PPCH, 2018). The questionnaire was piloted using three surveys to bring the total number of research participants to 403 customers. A systematic sampling approach was adopted by selecting every ninth customer exiting the supermarket entrance

to participate in the survey. The sampling interval was calculated by dividing the population size by the desired sample size (403). Key informant interviews were also conducted with experts from the Royal University of Phnom Penh.

A structured questionnaire was developed for the survey comprising five sections. The first section asked about the socioeconomic characteristics of the customers, such as gender, age, marital status, occupation, and income. The second section asked questions about plastic bag consumption, such as the frequency of supermarket visits, which supermarket people shopped at, the number of plastic bags used, and the purpose of plastic consumption. The third section inquired about the knowledge, attitudes, and practices of customers, such as where customers accessed information about plastic use; and their knowledge about plastic management (reuse, reduce, recycle) and plastic pollution. This section also included questions about customers attitudes related to the importance of reducing plastic bag consumption the inconvenience of measure in place to do so; as well as how customers use and manage plastic. These questions were intended to understand the actual practices of plastic bag usage in Phnom Penh. The fourth section asked questions to evaluate the WTP of customers to reduce plastic bag consumption through a bidding process. The final section of the questionnaire focused on general opinions about the reduction of plastic bag usage and other environmental solutions.

Socioeconomic characteristics, access to knowledge, attitudes, and practices of consumers were analyzed using descriptive statistics and a

frequency analysis, with the data visualized in tables and graphics. Data collected about WTP was assessed using one-way analysis of variance ANOVA), using a Tukey HSD Test. The test was used to determine the difference in the WTP of customers by occupation. The factors influencing plastic reduction were analyzed using a Binary Logistic Regression (Sung, 2010; Jayaraman et al., 2011), which used the following regression model:

$$\pi_i = \Pr\left(Y_i = \frac{1}{X_i} = x_i\right) = \frac{\exp(\beta_0+\beta_1 x_i)}{1+\exp(\beta_0+\beta_1 x_i)} \quad (1)$$

$$logit(\pi_i) = \log\left(\frac{\pi_i}{\pi_i-1}\right) = \beta_0+\beta_1 x_i \quad (2)$$

$$logit(\pi_i) = \log\left(\frac{\pi_i}{\pi_i-1}\right) = \beta_0+\beta_1 x_{i1} + \cdots +\beta_k x_{kn} \quad (3)$$

The results from the regression predicted the likelihood that a particular factor would contribute to a reduction in plastic bag consumption in supermarkets. The dependent variable "Do you reduce plastic bag when shopping" had two possible answers: Yes=1 and No=0. The logit distribution constraints estimated the probability as a value between 0 and 1. The independent variables used in the regression are identified (see Appendix 1). Analysis of the results was conducted using the SPSS 23 software package. Microsoft Excel was used to prepared charts, tables, and graphics for the report.

Result and Findings

Access to information, knowledge, attitudes, and practices

The characteristics of the supermarket customers surveyed were as follows. Overall, 63.3% of respondents were female, most were unmarried university students. Their monthly income was less than 250 USD. More than

half of the respondents (n=294) shopped at Aeon Mall 1 due to the facilities, level of services, and choice of items, compared to other supermarkets. The average age of respondents was 23. They came to the markets for food, drinks, and entertainment, such as movies, video games, and social gatherings.

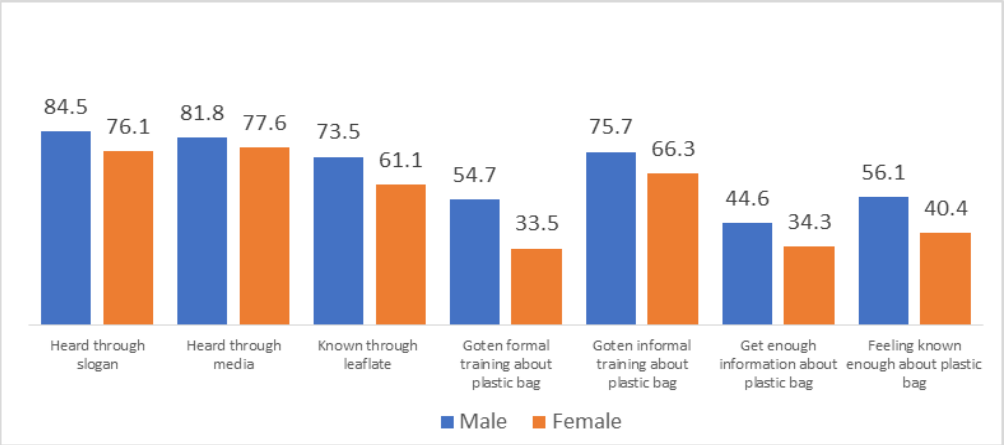
In Cambodia, training, slogans, leaflets, and social media have all been used to disseminate information to the public. Both male and female customers were found to have received information about plastic bags via slogans (male 84%, female 76%), leaflets (male 73%, female 61%), and social media (male 81.8%, female 77.6%). Slogans and social media were considered to be the most effective method of disseminating, resulting in widespread awareness of information about plastic bag use.

Training about plastic consumption was divided into informal and formal categories within this study. Informal training was found to be more effective in disseminating information than formal training (classes, courses, or schools). Women were found to be less likely to join formal training (33.5%) than informal training (66.3%). Similar outcomes were found for men who were less likely to join formal training (54.7%) than informal training (75.7%), but more likely to access training overall.

While customers indicated that they received information from slogans, leaflets, and social media, as well as informal and formal training, most customers felt that they did not receive sufficient information through these sources. Among the 403 customers surveyed, only 39% (male 44.6%, female

34.3%) claimed they received sufficient information. Women (40.4%) believed they had less access to information than men (56.1%).

Figure 3. Access to information about plastics by gender



Customer knowledge about plastic bags such as it creating an unclean living environment; damaging drainage systems; impacting health; and polluting water, land, and air were widely acknowledged; with no significant difference between men and women. However, when considering knowledge levels by occupation, there were significant differences. Those with 'other' careers had less substantial knowledge about the impacts of plastic bag consumption, compared to students, government officers, and those working in the private sector.

Moreover, while environmental knowledge about plastic bags was high, technical knowledge was low. For example, only 48% of customers surveyed knew how to classify plastic wastes. Women (45.1%) were found to have less technical knowledge than men (54.1%), with all customers having very limited knowledge of the plastic qualities and recycling codes. They were not

aware of which plastic products were eco-friendly, single-use, or multiple-use (see Figure 4).

Figure 4. Plastic using codes

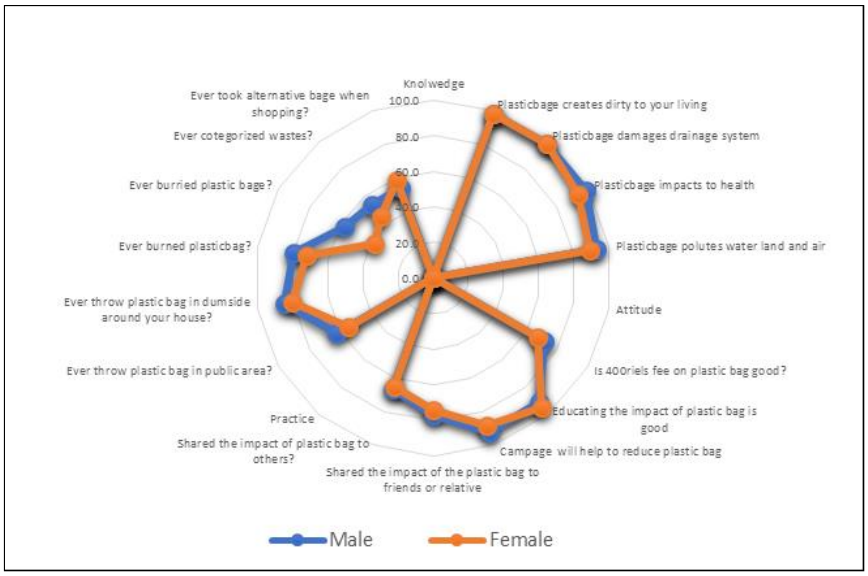
Source*:* (Wahab et al., 2006)

Positive attitudes related to plastic information and knowledge were found, with 92% of customers found to support Sub-Decree 168 and more than 68% agreeing that charging 0.10 USD per plastic bag was a good initiative for reducing plastic consumption in supermarkets. A high proportion of customers also supported education programs (92%) and awareness campaigns (89%) to reduce plastic use. Both men and women shared information and knowledge about the plastic bag with their relatives, friends (male 77%, female 74%), and other people (male 67%, female 65%). These positive attitudes demonstrate the connection between information and knowledge about plastic bags and consumer attitudes. However, customer attitudes towards plastic consumption and the inconvenience of reducing plastic bag use were not positive, which tends to be demonstrated in user practices.

It was found that single-use plastic bags were mostly used for foods and drinks and customers tended to use between a minimum of 1 plastic bag or a maximum of 7 plastic for each visit to the supermarket. Almost half of those

surveyed (43.8%) visited the supermarket at least twice per week. Survey respondents were found to use plastic bags due to their price (83%), convenience (95%), weight (96.8%), material (79.4%), and durability (61.8%). Customer attitudes were found to view plastic bag reduction as inconvenient, where they were aware that plastic caused problems, but could not reduce their consumption. Further, 57% of those surveyed indicated that they disposed of plastic waste in public areas; 81% disposed of plastic waste around their houses; 74% burned plastic waste; 44% buried plastic waste, while only 57% used alternatives to plastic bags for shopping.

Figure 5. Knowledge, attitudes, and practices related to a reduction in plastic bag use by gender



These results confirmed that a lack of detailed information and technical knowledge about the reduction of plastic use, as well as a perception of solutions being inconvenient led to plastic reduction policies and regulations in urban areas to be ineffective (Kum et al., 2005; Ritch et al., 2009). Figure 5

presents the results of the survey for the knowledge, attitudes, and practices of customers.

Willingness to Pay (WTP)

In response to the second research objective, the willingness to pay a plastic consumption fee was determined. It was found that 70.5% (n=280) of respondents indicated a positive WTP (min=0 KHR, mean=430 KHR, and max 2000 KHR). There was no significant difference in the WTP by gender, however, there was by occupation. A one-way analysis of variance using a Tukey HSD test revealed a significant difference between the WTP of students, those working in the private sector, and government officers; when compared to those working in other careers (P-*value* <0.05).

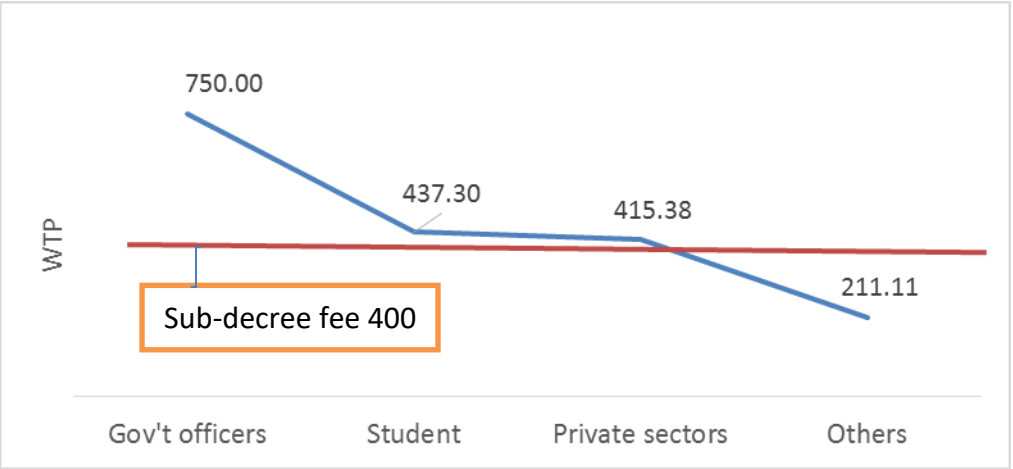
Government officers were found to have the highest WTP among these occupational groups. It was 321 KHR higher than the student group and 583 KHR higher than those working in other careers. However, the WTP of private-sector employees was not significantly different to students, government officers, or those working in other careers. Table 1 outlines the difference in WTP by different occupational groups at a significance level of 0.05 level (*).

Of the customers surveyed, 29.5% (n=117) were not willing to pay a fee to use a plastic bag (32.9% or n= 82 female; and 23% or n=32 male). They provided reasons including that they did not have money (7.6%); they would prefer to use an alternative bag (19.7%); that the supermarket should pay this fee instead of them (37.9%), or that they don't trust Sub-Decree 168 (4.5%).

Table 1. WTP for a plastic bag

(I) Occupation		Mean Difference (I-J)	Std. Error	P-*value*	95% Confidence Interval	
					Lower	Upper
Student	*Gov't officer*	-312.703*	118.429	0.044	-619.14	-6.27
	Private sector	21.913	76.400	0.992	-175.77	219.60
	Other	226.186	90.064	0.061	-6.85	459.23
Gov't officer	*Student*	312.703*	118.429	0.044	6.27	619.14
	Private sector	334.615	135.734	0.068	-16.60	685.83
	Other	538.889*	143.869	0.001	166.63	911.15
Private sector	*Student*	-21.913	76.400	0.992	-219.60	175.77
	Gov't officer	-334.615	135.734	0.068	-685.83	16.60
	Other	204.274	111.848	0.264	-85.13	493.68
Other	*Student*	-226.186	90.064	0.061	-459.23	6.85
	Gov't officer	-538.889*	143.869	0.001	-911.15	-166.63
	Private sector	-204.274	111.848	0.264	-493.68	85.13

Figure 6. *Average WTP for a plastic bag by occupation*



The fact that customers believe that the supermarkets should pay a plastic consumption fee indicates an attitude of inconvenience. The average WTP of supermarket customers was found to be higher than the fee introduced by Sub-Decree 168 (400 KHR).

Factors influencing a reduction in plastic bag consumption

This study used Binary Logistic Regression thresholds recommended by (Hair et al., 2014) and (Leech et al., 2014) to assess the significance of various factors in influencing a reduction in plastic bag usage; including significance levels (P-value <.05), Wald Statistics (χ^2>2) and Cox & Snell (R^2 <0.05). It was verified that a reduction in the use of plastic bag consumption was influenced by socioeconomic factors, access to information, knowledge, attitudes, and practices.

The results from the binary logistic regression were used to identify the most significant factors influencing a reduction in plastic bag. $Wald\ Statistic\ \chi^2\ (26,\ N = 195) = 108$, P-value <0.001 suggests that between 42% and 59% of the variance in influence could be explained by 26 independent variables (Appendix 1). This was supported by a Hosmer and Lemeshow Test, which gave $a\ Wald\ Statistic\ \chi^2\ (8, N = 195) = 6.2$, P-value >0.05. The threshold value of 0.500 predicted a percentage of agreeance with the model of 85.1% (PAC=85.1%), with an error of less than 15%. Detailed results from these statistical models are shown in Appendix 2. They include a coefficient (B), the standard error related to the coefficient (S.E.), the, Wald Statistic = $[B/S.E.]^2$, the number of degrees of freedom (d.f), the significance level of the coefficient (Sig), and the odds ratio of the individual coefficient Exp(B).

Of the eight independent variables related to the socio-economic characteristics of customers, two (*marital status* and *number of years residing in Phnom Penh*) had a negative influence on the reduction of plastic bag consumption. Other factors such as sex, age, educational level, household expenditure, time of purchase, and the number of plastic bags

used had no significant influence on the likelihood of reducing plastic bag use (P-value >0.05). None of the four independent variables associated with access to knowledge (*plastic bags create an unclean living environment; plastic bags damage drainage systems; plastic bags impact health; plastic bags pollute water, land, and air)* was found to have a significant influence on the reduction of plastic bag use. The attitudinal factors *education on the impacts of plastic bags is good* was not a significant influence, however, *plastic reduction campaigns will reduce plastic bag consumption* was found to have a positive influence (P-value <0.05, odds ratio = 10.66).

Of the five independent variables linked to access to information on plastic bag consumption, only two were found to have a significant influence. *Hearing a slogan about plastic bags* was positive correlated with a reduction in plastic bag consumption (P-value <0.05, odds ratio = 5.44), however s*haring information about the impact of the plastic bags with friends or relative* had a negative correlation. Customers who had never shared information about the impact of plastic bags were also not likely to reduce their consumption (P-value <0.05, odds ratio = 0.24).

Finally, of the seven independent variables associated with customer practices, two were found to have a significant influence on the reduction of plastic bag use: *joining events or campaigns to collect the plastic bags,* and *obeying the sub-decree* (P-value <0.05, Odd ration=4.65, odds ratio = 7.48). A singled variable was associated with a negative likelihood for reducing plastic bag consumption - *taking alternative bags to the supermarket* (P-value <0.05, odds ratio = 0.26). Put simply, customers who have never used an alternative bag for a supermarket visit are unlikely to reduce their consumption of plastic bags.

Discussion

In Cambodia, information about plastics is transferred to the public through several methods. Customers access information about plastic bags via slogans (male 84%, female 76%), leaflets (male 73%, female 61%), and social media (male 81.8%, female 77.6%). However, most respondents (61%) feel that they lack information about plastic consumption. Knowledge about plastic bags creating unclean living environments; damaging drainage systems; impacting health; and polluting water, land, and air was strong. However, customers tended to have limited technical knowledge about plastic bag recycling, with only 48% of respondents knowing how to classify plastic wastes using plastic codes. Attitudes towards reducing plastic consumption were positive, but the inconvenience of reducing plastic bag usage was negative. Thus, respondents were still found to use a large number of plastic bags each trip to the supermarket (between 1 and 7 bags). In terms of disposing of waste, 57% of respondents reported throwing waste into public areas; 81% threw plastic wastes in areas surrounding their houses; 74% burned plastic wastes; 44% buried burry plastic wastes, and 57% reduced plastic use by taking alternative bags when shopping.

Information on plastic usage is considered to be a major contributing factor in the reduction of plastic use (Brucks, 1985). There are considered to be two reasons why information is lacking among customers. The first is that even when respondents access lots of information in the forms of slogans, leaflets, and social media, these platforms do not provide detailed information. They are not suitable for sharing technical information or

knowledge about policies related to plastic consumption. The second is related to policies and regulations and their enforcement (Koeng et al., 2020). When there is limited information on regulations and policies, people are more likely to be careless, which affects the control and management of plastic consumption (Edwards & Kellett, 2000). Often customers have limited technical knowledge of plastic bag usage.

This insight is reflected in the results of a study by (Hasan et al., 2015) who found that consumers generally access knowledge about the environment (e.g. plastic wastes pollutes the environment, impacts health, and kills marine life), which makes a significant contribution to the intention to reduce plastic consumption. However, customers often do not access technical knowledge about how plastic bags may impact their health. Plastic codes may be considered too technical to understand, which is why they are not widely understood by the public.

The study also supported findings that there are two important attitudes related to plastic consumption (Laroche et al., 2001). An attitude associated with the inconvenience of reducing plastic consumption is considered to be highly significant amongst consumers. Even though it is well-known that plastic bags pollute the environment and impact health, it is difficult (or inconvenient) to reduce plastic consumption. It was found that 29.5% of respondents (n=117) did not want to pay a fee to use a plastic bag. While they were active in sharing information about the impacts of plastic bags with relatives, friends, and other people, they did not take action where it is important. Chow et al., (2017) identified that while access to information,

knowledge, and attitudes lead to good practices; factors such as limited detailed information and an attitude of inconvenience leads to limited outcomes with respect to a reduction in plastic bag use among supermarket customers.

Customer practices and willingness to pay

The survey was conducted with highly educated participants (96.3% were university educated), however, the number of plastic bags used for each supermarket visit was high (between 1 and 7 bags). The factors leading to customers using plastic bags were their price (83%), convenience (95%), weight (96.8%), material (79.4%), and durability (61.8%). These findings confirmed those of (Verghese et al., 2006; Adane & Muleta, 2011). Consumers were also found to believe that plastic bags that contain the logos of reputable brands are desirable, hygienic and convenient.

The WTP for plastic bag use was found not to influence the number of plastic bags used. This suggests that Sub-Decree 138 was ineffective in deterring the use of plastic bags, despite a fee of 400 KHR (0.10 USD) being charged. Most customers had a higher WTP than the fee. Considering the results presented in Figure 6, the Royal Government of Cambodia should regulate an increase in the fee to 500 KHR (0.125 USD) to make it more effective in reducing plastic bag use among customers.

Factors influencing a reduction in plastic bag consumption

The factors influencing plastic reduction were indicated by the results of a Binary Logistic Regression $Wald\ Statistic\ \chi^2(26, n = 195) = 108$, P-value <0.001. Between 42% and 59% of the variance was shown to be

explained by 26 independent variables. This was supported by a Hosmer and Lemeshow Test which gave $Wald\ Statistic\ \chi^2(8, n = 195) = 6.2$, P-value >0.05 with (PAC=85.1%). These results show that access to information, attitudes, and good practices has a significant influence on reducing plastic bag consumption.

The impact factor associated with attitudes demonstrates the importance of the campaigns to raise public awareness. In this regard, campaigns are shown to be effective in transferring information and knowledge to customers. This result is similar to that of (Quicksand, 2015) who conducted campaigns to raise awareness on putting a larger number of items in a plastic bag. While attitudes were positive towards the importance of reducing plastic bag consumption, the inconvenience of reducing plastic bag use was still of concern to 57% of customers, who used alternative bags for supermarket visits.

Slogans were also found to be a factor in reducing plastic bag consumption. However, their impact was limited to spreading environmental knowledge and information to customers. For example, the slogan *plastic bag creates trash; impacts health; and pollutes water, land, and air*. More technical knowledge such as *reuse, reduce, recycle* and *waste management* requires knowledge transfer by other methods. Slogans are not well-suited to conveying detailed information in law and regulations. In this instance, methods such as television, radio, and social media platforms should be considered.

Good plastic use practices were also influencing factors in the reduction of plastic bag consumption. Applying plastic waste collection practices and charging a fee to use plastic bags was shown to influence consumer attitudes and behavior. The above activities persisted among supermarket customers and were shown to reduce plastic bag consumption.

Limitations

Two limitations affected the study. The first was missing data from respondents. As the survey was conducted at the supermarket gates, respondents considered the timing and environment of the survey to be inappropriate. As a result, only 239 respondents were analyzed in the one-way Anova test; while only 195 respondents were analyzed in the binary logistic regression out of a total of 403 surveys. In future studies, the time and location of the study should be considered more carefully. The second was the response rate of different consumer types. Applying a systematic sampling method of selecting every ninth customer resulted in an over-representation of students in the sample. Future studies should apply purposive sampling to remedy this issue (Dnscombe, 2014). In addition, the study should include an assessment of the significance of the behavior of sellers in influencing the use of plastic bags.

Conclusion

Based on the findings of this study, it is concluded that: limited access to information and a poor attitude towards the inconvenience of not using plastic bags has constrained the reduction of plastic bag consumption in Cambodian supermarkets. This has resulted in the high-level use of plastic

bags (1-7 supermarket visit). The WTP of government officers was found to be higher than that of students (321 KHR) and greater than that of other occupations (538 KHR). However, the difference between these different users and private employees was found not to be significant. The WTP of consumers 400 KHR was found to be significantly lower than the fee scheduled in Sub-decree 168. Despite this, the fee was shown not to influence the number of plastic bags they used. Thus, increasing the fee by 500 KHR is recommended as a further incentive to reduce plastic bag consumption in supermarkets. A binary logistic regression showed that access to information, attitudes, and practices were significant in influencing a reduction in plastic bag consumption.

In future studies, it is recommended that a research framework is designed to explore consumer awareness of the disadvantages of using plastic bag use, particularly those related to SDG-13 on Climate Action, SGD-14 on Life Below Water, and SDG-15 on Life on land. This study supports the conclusion of Ritch et al., (2009) that decoupling consumer behavior from the consumption of plastic bags required to achieve sustainable consumption, as a precursor to sustainable development. Policymakers should continue to encourage people who already use reusable bags, even if this has minimal impact on infrequent users (Rivers et al., 2017). Prospect theory demonstrates that perceptions in the changed of price may be influenced more by the frequency of their purchase, rather than the amount of expenditure. By this view, price increases may have a larger impact on perceptions than price decreases (Kahneman & Tversky, 2013). Thus,

policymakers in the Ministry of Environment and business owners play an important role in increasing the price of plastic bags. In 2008, this was demonstrated by the Chinese government, who introduced a nationwide regulation requiring all retailers to charge for plastic shopping bags to reduce plastic bag litter. Enforcement of this regulation has shown to impact consumer attitudes. The socioeconomic characteristics of consumers were also found to affected plastic bag consumption (He, 2012).

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Biography

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Appendix

Appendix 1. Independent variables included in the regression

Independent variables	Measurement	Value
Socioeconomic characteristic		
1. Sex	Nominal	Male=1, Female=2
2. Age	Numeric	Number
3. Marital status	Nominal	Married=1, widow=2, Single=3
4. Education level	Ordinal	Non education=1, Vocational training=2, Primary=3, Secondary=4, High school=5, University=6
5. Household expenditure	Numeric	USD ($)
6. Year of residing in PP	Numeric	Number
7. Time of supermarket visit	Numeric	Number
8. Number of plastic bags used	Numeric	Number
Knowledge		
9. Plastic bags create an unclean living environment	Nominal	Yes=1, No=0
10. Plastic bags damage drainage systems	Nominal	Yes=1, No=0
11. Plastic bags impact health	Nominal	Yes=1, No=0
12. Plastic bags pollute water, land, and air	Nominal	Yes=1, No=0
Attitudes		
13. Education on the impacts of plastic bags is good?	Nominal	Yes=1, No=0
14. Plastic reduction campaigns will reduce plastic bag consumption?	Nominal	Yes=1, No=0
Access to information		
15. Through slogans?	Nominal	Yes=1, No=0
16. Through the media?	Nominal	Yes=1, No=0
17. Through leaflets?	Nominal	Yes=1, No=0
18. Through friends or relative?	Nominal	Yes=1, No=0

19. Through providing information to others?	Nominal	Yes=1, No=0
Practices		
20. Taking an alternative bag to the supermarket?	Nominal	Yes=1, No=0
21. Joining events or campaigns to collect plastic bags?	Nominal	Yes=1, No=0
22. Cooperating by using an alternative bag?	Nominal	Yes=1, No=0
23. Obeying the sub-decree?	Nominal	Yes=1, No=0
24. Paying to use a plastic bag?	Nominal	Yes=1, No=0
25. WTP for a plastic bag?	Numeric	KHR
26. Sorting wastes?	Nominal	Yes=1, No=0

Appendix 2. Factors influencing a reduction in plastic bag consumption

Factor	B	S.E.	Wald	d.f	Sig.	Exp(B)
Socioeconomic characteristic						
1. Sex	-0.704	0.555	1.609	1	0.205	0.494
2. Age	-0.055	0.092	0.354	1	0.552	0.947
3. Marital status	-1.881	0.846	4.947	1	0.026	0.152
4. Educational level	-1.403	1.832	0.587	1	0.444	0.246
5. Household expenditures	0.001	0.003	0.112	1	0.738	1.001
6. Years of residing in PP	-0.138	0.038	12.920	1	0.000	0.871
7. Time of purchase	0.268	0.152	3.092	1	0.079	1.307
8. Number of plastic bags used	0.066	0.551	0.014	1	0.904	1.069
Knowledge						
9. Plastic bags create an unclean living environment	0.596	1.532	0.151	1	0.697	1.815
10. Plastic bags damage drainage systems	20.225	40192	0.000	1	1.000	60786
11. Plastic bags impacts health	1.472	1.109	1.763	1	0.184	4.359
12. Plastic bags pollute water, land, and air	0.237	0.653	0.132	1	0.716	1.268
Attitudes						

13. Education on the impacts of plastic bags is good?	1.502	1.245	1.454	1	0.228	4.489
14. Plastic reduction campaigns will reduce plastic bag consumption?	2.367	0.869	7.410	1	0.006	10.662
Access to Information						
15. Through slogans?	1.695	0.625	7.365	1	0.007	5.446
16. Through the media?	-1.377	0.721	3.650	1	0.056	0.252
17. Through leaflets?	1.037	0.586	3.133	1	0.077	2.822
18. Through friends or relative?	-1.428	0.693	4.251	1	0.039	0.240
19. Through providing information to others?	-0.006	0.565	0.000	1	0.992	0.994
Practices						
20. Taking an alternative bag to the supermarket?	-1.322	0.595	4.933	1	0.026	0.267
21. Joining events or campaigns to collect plastic bags?	1.537	0.613	6.294	1	0.012	4.650
22. Cooperating by using an alternative bag?	1.589	2.403	0.437	1	0.508	4.899
23. Obeying the sub-decree?	2.012	0.848	5.627	1	0.018	7.482
24. Paying to use a plastic bag?	0.222	0.513	0.188	1	0.664	1.249
25. WTP for a plastic bag?	-0.001	0.001	1.129	1	0.288	0.999
26. Sorting wastes?	0.728	0.476	2.345	1	0.126	2.072
Constant	-12.60	40192	0.000	1	1.000	0.000